TEST OF THE GEOTHERMAL POTENTIAL OF THE EDNA DELCAMBRE NO. 1 VERMILION PARISH, LOUISIANA

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ABSTRACT

In 1977 the on-site operations began on the Edna Delcambre No. 1 to evaluate the geothermal potential of high-pressure, high-temperature salt-water-bearing sands which are common to the Gulf Coast region. This project, which was funded by the Energy Research and Development Administration (ERDA), tested two sands of the Planulian sand series. A discussion of the problems encountered, tests conducted, and equipment used, along with a summary of the results is presented in this paper.

The Energy Research and Development Administration contracted Osborn Hodges Roberts Wieland Engineering to administer and conduct the activities involved in securing reservoir data and flow tests from the Edna Delcambre No. 1, a depleted gas well. The Edna Delcambre No. 1 is located in Section 5, Township 14 South, Range 5 East, Vermilion Parish, Louisiana. The well site is just above Vermilion Bay and approximately 40 miles south of Lafayette. ERDA desired information concerning the geothermal potential of high-pressure, high-temperature, water-bearing formations along the Gulf Coast. This was the first actual test.

OHRW Engineering acquired the rights to test the well and acquired ownership of the existing production equipment. Bid requests for services and equipment needed for the project were submitted to potential subcontractors. The actual on-site work began approximately 1-1/2 years after the initiation of the project. Two salt-water-bearing sands were flow tested. The deeper sand (12,900 ft) designated as Sand No. 3 was tested first. The shallower sand (12,500 ft) designated Sand No. 1 was tested last. These sands were of Planulina series and were tested on the eastern flank of the basin.

Questions to which answers were sought are as follows:

1. What is the formation equilibrium temperature?
2. What is the bottom-hole pressure?
3. What flow rate can be achieved without sand production?
4. How does the reservoir respond to different flow rates?
5. How much gas is dissolved in the salt water?

Many other questions were posed, but the critical questions certainly were those relative to the formation performance. The raw data and the conclusions have been submitted in detail to ERDA in the form of a final report. This report should be available to the public by summer, 1978.

This project demonstrated that the two salt-water-bearing sands were saturated with natural gas, that the thermal potential was lower than anticipated, that quantities of 12,000 barrels of water per day can be produced from some sands without sand matrix failure, and that this test is a step—though certainly a small one—in the development of a new energy source. Much more, however, has to be done in the evaluation of this energy source and its application in industrial use. Untold amounts of natural gas, thermal energy, and hydraulic energy exist in huge aquifers along the Gulf Coast, but the problems involved in recovering this energy have tipped the economic scales in favor of conventional energy sources for the present.

The photographs that follow illustrate many of the procedures and equipment items used during this test.

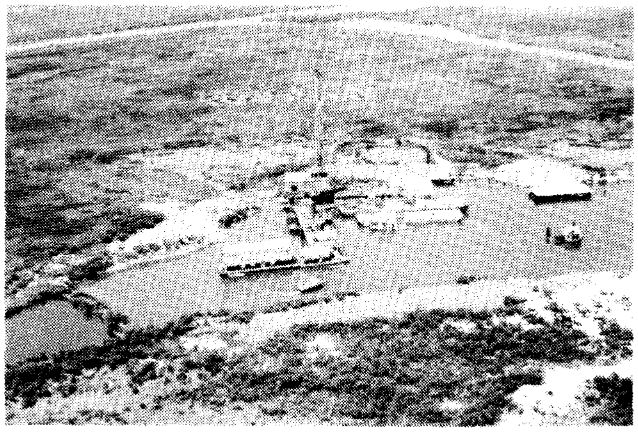

FIGURE 1—AERIAL PHOTO OF WELL SITE.

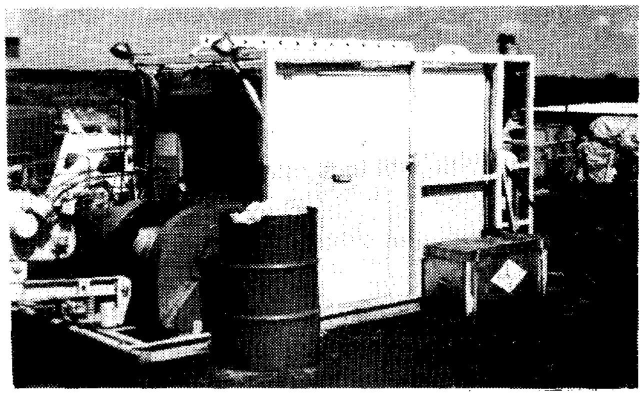

FIGURE 2—CAMCO'S ELECTRIC WIRELINE UNIT. THE HEWLETT-PACKARD QUARTZ CRYSTAL DOWNHOLE PRESSURE GAUGE WITH A TEMPERATURE TOOL WAS USED FOR MONITORING THE BOTTOM-HOLE PRESSURE AND TEMPERATURE. THIS PHOTO SHOWS THE ELECTRIC WIRELINE UNIT AND ELECTRIC WIRELINE ON WHICH THE TOOLS WERE RUN. THE TOOLS TRANSMITTED A SIGNAL BACK TO THE SURFACE VIA THE ELECTRIC WIRELINE.

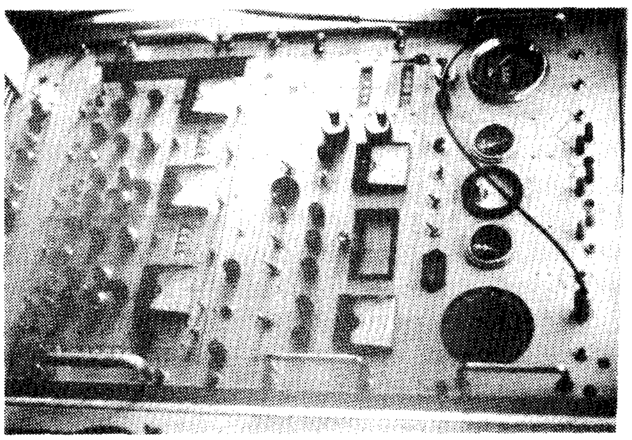

FIGURE 3—CONTROL PANEL INSIDE WIRELINE UNIT. THE DEPTH OF THE TOOL, THE FREQUENCY RESPONSE FROM THE TOOL, THE BOTTOM-HOLE TEMPERATURE, AND THE TENSION IN THE ELECTRIC LINE ARE DISPLAYED ON THE CONTROL PANEL AND WEIGHT INDICATOR.

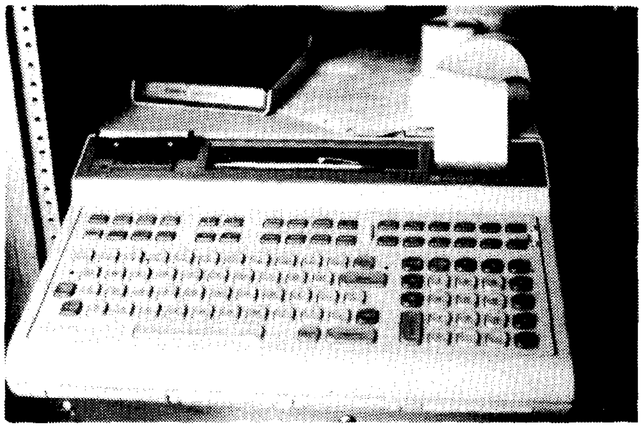

FIGURE 4—HEWLETT-PACKARD SIGNAL CONVERTING COMPUTER. THE COMPUTER ACCEPTED DATA TYPED IN ON THIS CONSOLE. INSTRUCTIONS FOR DATA PRESENTATION AND VARIATIONS OF TIME BETWEEN DATA PRINTINGS WERE GIVEN TO THE COMPUTER.

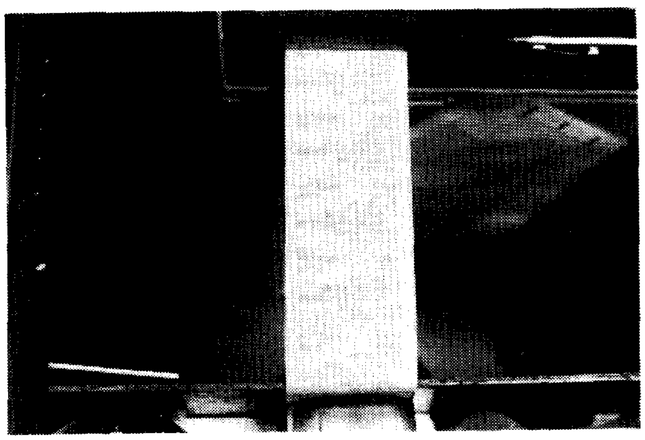

FIGURE 5—DATA PRESENTATION. THIS PRESENTATION GIVES REAL TIME, LAPSED TIME, BOTTOM-HOLE TEMPERATURE AND BOTTOM-HOLE PRESSURE RECORDED TO 0.01 psi. NOTE THAT THE TEMPERATURE IS 0°F. AFTER OBSERVING THAT THE BOTTOM-HOLE FLOWING TEMPERATURE DID NOT CHANGE MORE THAN 3°F, IT WAS DECIDED TO REMOVE THE TEMPERATURE TOOL FROM THE TANDEM ARRANGEMENT TO ELIMINATE A POTENTIAL SOURCE OF TROUBLE. THE 0-RING SEAL BETWEEN THE SIGNAL CONVERTER AND THE TEMPERATURE TOOL HAD LEAKED DURING EARLIER RUNS, THEREBY SHORTING OUT THE SIGNAL FROM THE TOOL.

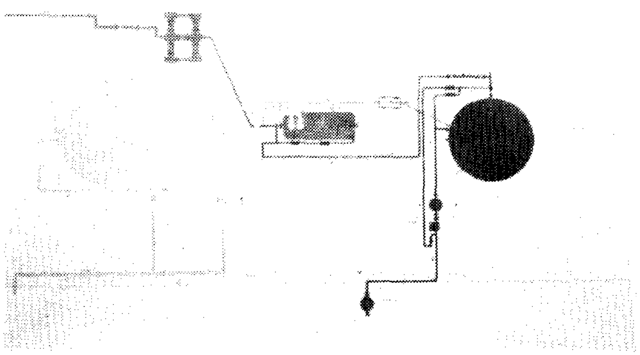

FIGURE 6 PIPING DIAGRAM. THIS IS A DIAGRAM OF THE EQUIPMENT AS IT WAS ARRANGED ON THE TEST BARGE. IN THE UPPER LEFT-HAND CORNER IS THE CHOKE MANIFOLD. DURING THE FLOW TEST, THE POSITIVE CHOKES WITH CERAMIC INSERTS WERE USED. THE PRODUCED FLUIDS FLOWED THROUGH THE CHOKE MANIFOLD TO THE HORIZONTAL 3-PHASE SEPARATOR. HERE THE NATURAL GAS WAS SEPARATED FROM THE WATER (WATER TO THE DISPOSAL WELL, GAS TO THE FLARE). THE SEPARATOR, 48 IN. IN DIAMETER, OPERATED NORMALLY BETWEEN 600 AND 900 psig. THE SEPARATOR HAD A 97% EFFICIENCY COMPARING NATURAL GAS SOLUBILITY IN THE FORMATION SAMPLER AND THE NATURAL GAS FOUND IN THE WATER DOWNSTREAM OF SEPARATOR. THE SIGNIFICANCE OF THE HIGH SEPARATOR EFFICIENCY IS THAT RETENTION TIMES MAY BE CUT SHORTER AND/OR SMALLER SEPARATORS USED IN FUTURE PROJECTS. THE GAS LEAVING THE SEPARATOR WAS METERED BEFORE AND AFTER ENTERING THE SCRUBBER TANK AND WAS THEN FLARED. AFTER LEAVING THE SEPARATOR, THE WATER COULD TAKE THREE DIFFERENT PATHS TO THE DISPOSAL WELL: THE FIRST WAS THROUGH THE SETTLING TANK; THE SECOND THROUGH THE INJECTION PUMP SUCTION; AND THE THIRD DIRECTLY TO THE DISPOSAL WELL.

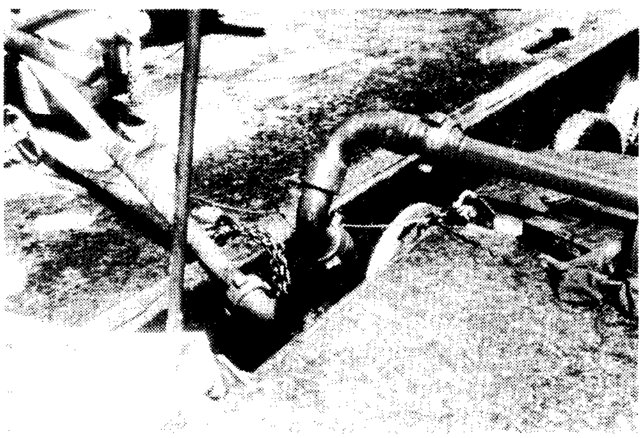

FIGURE 7 FMC CHICKSAN JOINTS. THE CHICKSAN JOINTS WERE USED TO COUPLE THE RIG WHICH WAS STATIONARY TO THE TEST BARGE WHICH WAS FLOATING. THEY ALLOWED FOR TIDAL VARIATION, EXPANSION, AND OTHER MOVEMENT.

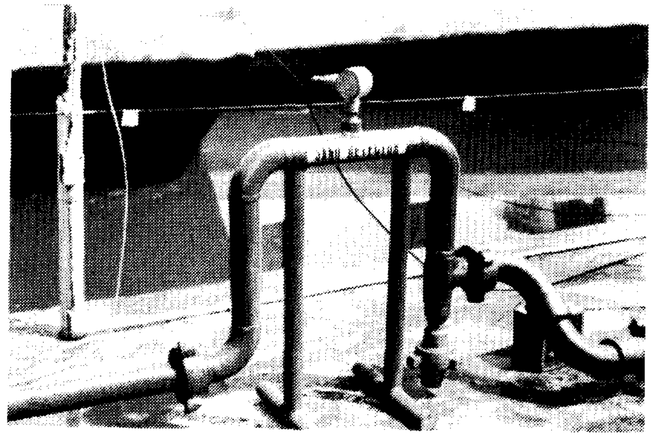

FIGURE 8 OCEANOGRAPHY INTERNATIONAL'S SONIC SAND DETECTOR. THIS PROVIDED EARLY WARNING OF INCREASES IN SAND PRODUCTION. A 3/4-IN. STAINLESS STEEL PROBE WAS INSERTED HERE IN THE 3-IN. FLOW LINE.

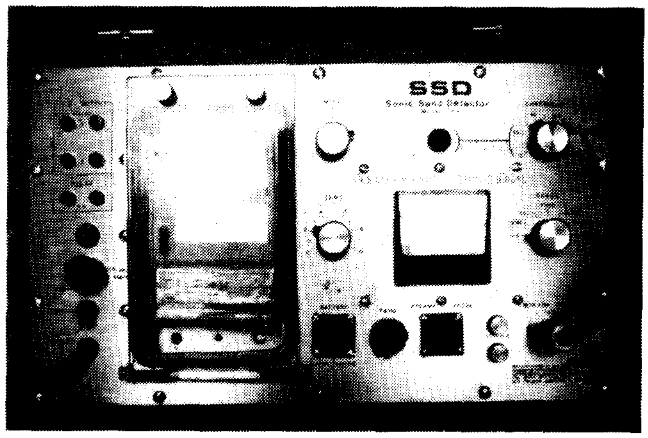

FIGURE 9—SAND DETECTOR READOUT. THE STRIP CHART IS PRESENTED AS SAND PRODUCTION INTENSITY VS TIME.

FIGURE 10—CATCHING WATER SAMPLE FROM CHOKE MANIFOLD. RECORDS WERE KEPT OF ACTUAL SAND SHAKE OUT. HERE A WATER SAMPLE IS BEING COLLECTED.

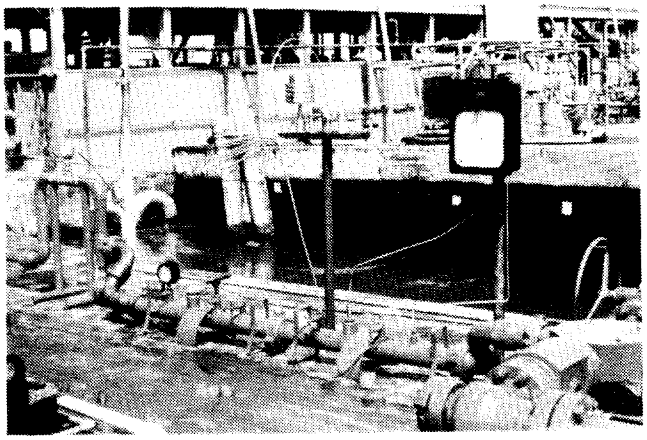

FIGURE 11—DATA HEADER AND DEAD WEIGHT TESTER WITH AN INLINE CORROSION COUPON. THE COUPON, MADE OF MILD STEEL, WEIGHED APPROXIMATELY 38 GRAMS. A SLIGHT WEIGHT LOSS WAS NOTED OVER THE DURATION OF THE FLOW TESTS. NEXT IN LINE WAS THE DEAD WEIGHT TESTER. IT WAS USED TO CHECK GAUGE AND CHART RECORDS FOR ACCURATE PRESSURE READINGS. THE BARTON RECORDER WAS USED FOR PRESSURE AND TEMPERATURE DATA COLLECTION. THESE PARAMETERS WERE RECORDED ON CIRCULAR CHARTS THAT WERE CHANGED EVERY 24 HOURS. THIS PROVIDED A HARD COPY OF THE DATA.

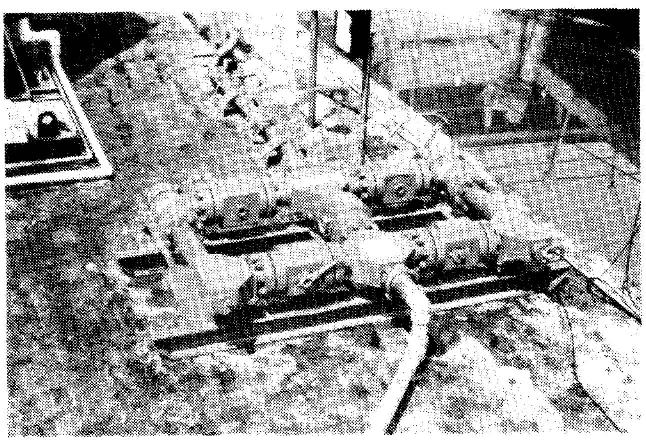

FIGURE 12—CHOKE MANIFOLD. THE MANIFOLD CONSISTED OF FIVE 3-IN. HALLIBURTON LO-TORC PLUG VALVES, A CAMERON POSITIVE CHOKE ON THE UPPER LEFT-HAND CORNER, AND A CAMERON ADJUSTABLE CHOKE ON THE UPPER RIGHT-HAND CORNER. THE ADJUSTABLE CHOKE WAS USED TO MAINTAIN FLOW THROUGH A PARTICULAR CHOKE SIZE WHILE THE INSERT WAS BEING CHANGED IN THE POSITIVE CHOKE BODY.

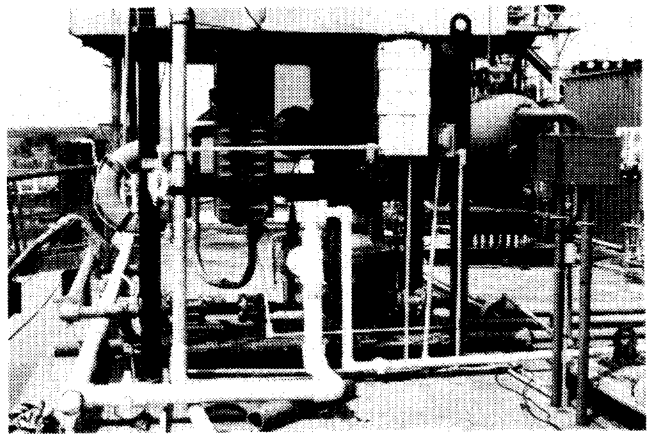

FIGURE 13—SUN DYNE PUMP. THIS INJECTION PUMP WAS CAPABLE OF DISPOSING OF 10,000 BARRELS OF WATER PER DAY AGAINST A 550 psi BACK PRESSURE. IT TOOK 350 kW TO START THE PUMP AND 125 kW TO OPERATE IT UNDER NORMAL LOAD CONDITIONS.

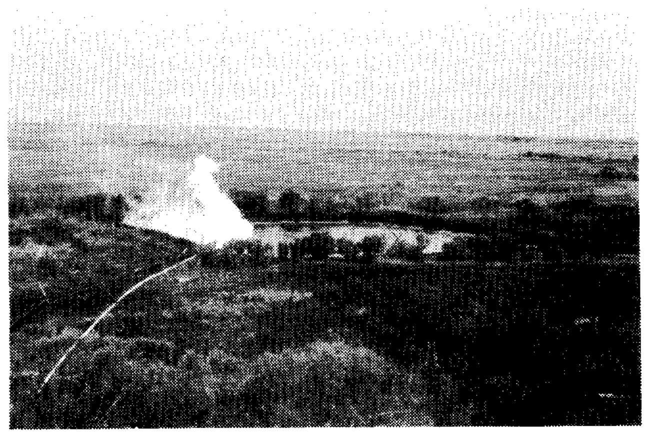

FIGURE 14—FLARE. THE PRODUCED GAS WAS BURNED HERE OVER THE MUD PIT.

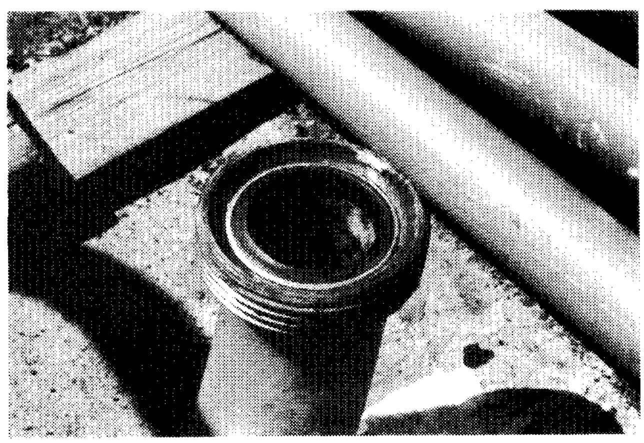

FIGURE 15—CHICKSAN SEAL RING. THE CHICKSAN JOINTS BEGAN TO LEAK PARTICULARLY AFTER A FLOW TEST HAD BEEN CONDUCTED, THE PRESSURE RELIEVED FROM THE SYSTEM, AND THE SYSTEM REPRESSURED. THE SEAL RING FAILED.

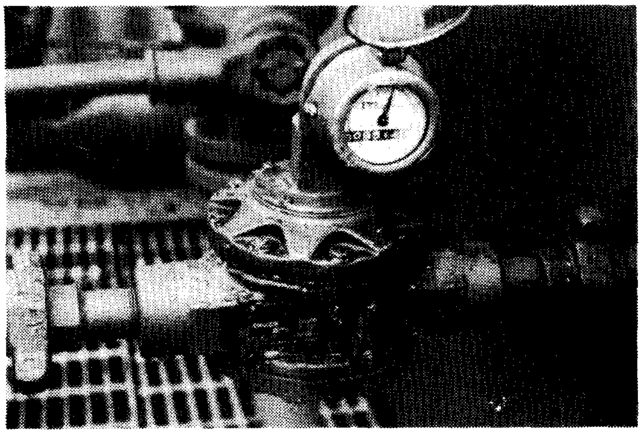

FIGURE 16 ITT BARTON FLOW TRACT METER. TEMPERATURE AND PRESSURE CONDITIONS EXCEEDED THE DESIGN LIMITATIONS OF THIS METER. A MORE SUITABLE METER WAS PLACED IN SERVICE.

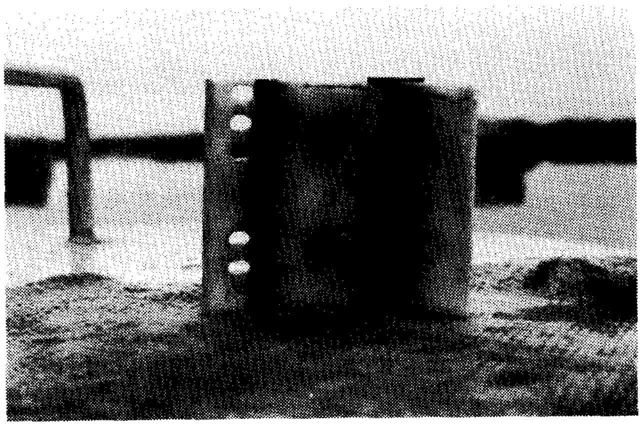

FIGURE 17 DAMAGED IMPELLER FROM BARTON FLOW TRACT METER. THE EXTREME PRESSURE AND TEMPERATURE CONDITIONS DESTROYED THE COVERING ON THE IMPELLER BODY.

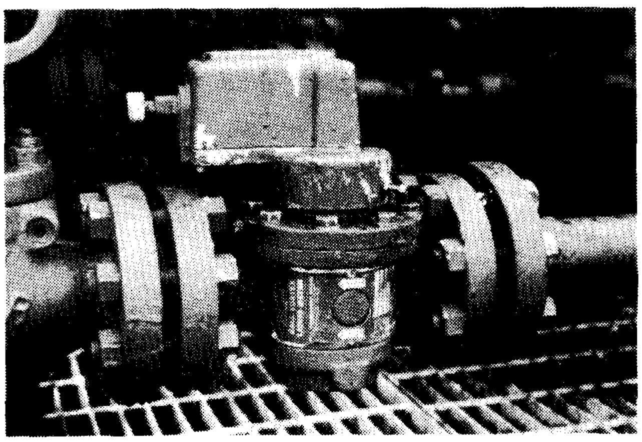

FIGURE 18 BALL VORTEX METER. THIS IS THE REPLACEMENT METER FOR THE DAMAGED FLOW TRACT METER.

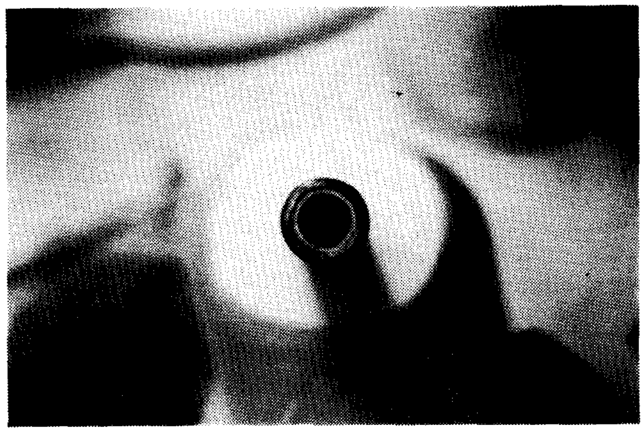

FIGURE 19—$CaCO_3$ SCALE IN 1-IN. PIPE. THE PRODUCED WATER HAD A HIGH $CaCO_3$ CHARACTERISTIC. AS THE PRESSURE AND TEMPERATURE CONDITIONS WERE REDUCED, THE $CaCO_3$ PRECIPITATED RESULTING IN THIS SCALE BUILDUP.

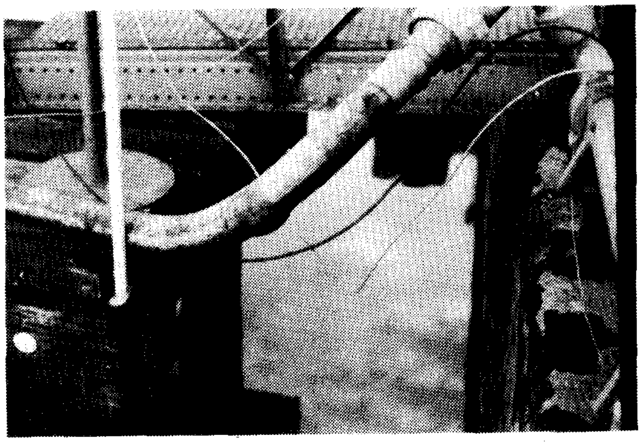

FIGURE 20—BLISTER ON RUBBER HOSE. THE HARSH CONDITIONS TOOK A TOLL ON THE RUBBER PRODUCTS AS IS EXEMPLIFIED HERE BY THIS HOSE CONNECTING THE BARGE TO THE DISPOSAL WELL.

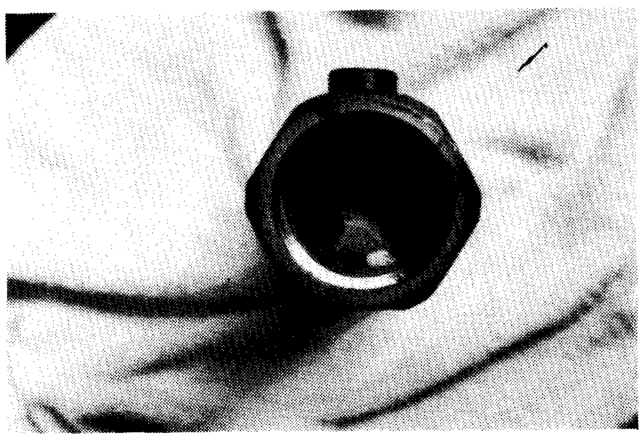

FIGURE 21—FRAGMENT OF CERAMIC CHOKE IN TURBINE METER COATED WITH $CaCO_3$. A CERAMIC INSERT IN A POSITIVE CHOKE SHATTERED AND A PIECE WAS FOUND IN THE TURBINE METER AHEAD OF THE DISPOSAL WELL TREE. THE CERAMIC INSERT WAS EXPOSED TO CONDITIONS FOR WHICH IT WAS NOT DESIGNED, AND THE FAILURE WAS NOT DUE TO AN INFERIOR INSERT. THE FORCE OF THE WATER PRESSURE CARRIED THIS FRAGMENT THROUGH THE SEPARATOR AND FINALLY LODGED IT HERE.